

(18) In order to solve the above-described problems, a tracking means capable

objects expressed into the same mathematical elements. In many cases, however, a changing view sustained on the basis of a difference does not necessarily amount to a specific portion of an object.

Any example, the natural one

(1) Character of telephones, due to their location, varies.

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transmission the whole associated processing system may not operate efficiently. If the above association processing scheme fails or does not properly describe a described above, various problems are posed when it is applied to a monitoring system (display monitoring system).

[illegible]

As a method of tracking suspected targets in a sensitive area, the following method is also suggested. The method employs a change covering tables for detection of a changing area which changes due to the movement of a moving object; such as an intruder, with a reading device used for the changing area directed by the change covering means. With this arrangement, the change covering means is present in the changing area is constant.

14 For example, the following tracking methods are employed by the tracking means described above:
(1) tracking changes in brightness (pixel luminance) in a tracking area.

(c) tracking a specific target in a tracking area; and
 (d) determining a tracking direction by analyzing the
 normalized value between a tracking area and peripheral
 areas.

Since a given tracking means can track only a portion
 of a moving object, the following method is also pro-
 posed. In this method, after tracking processing is com-
 pleted, tracking results are analyzed, and the tracking
 means are divided into groups in terms of moving ob-
 jects. For example, the tracking means are classified in groups



(95) (5) In the above embodiments, only the sizes of changing areas are taken into consideration to determine which one of the areas is to be tracked. However, if a changing area is selected in consideration of information about the shapes of changing areas in addition to their sizes, a target can be more reliably selected. Since the contour of a still object tends to be mistaken for a changing portion due to the difference between the contour and the background, the following processing may be additionally performed: removing edges such as the contour mentioned above, or neglecting changes occurring at

always expanded into the same surrounding elements. In every case, however, a changing area occurred at the back of a difference does not necessarily correspond to a specific portion of an object.

* For example, the sentence "The cat is on the mat" is a sentence in English, but "The cat is on the mat" is not a sentence in French.

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components caused by environmental conditions contribute to changes in behavior due to habituation. Variations or changes in behavior at a given place due to reflecting by a mirror surface at the very end of time and place have significance in persons under study in training object. In the experimental method, therefore, subjects to be observed cannot be reliably and satisfactorily detected by considering the outer appearance.

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(2) These differences of policy on the line extend to an picking up questions by no longer picking out any particular question with to answer or the like, it is very difficult to clearly separate the question of the line from the whole. That is, it is very difficult to extend the line to one area or to another.

As a method of solving the above-stated problems, a final estimator, pricing scheme (Published in Unpublished Technical Paper Approximate Dec. 2-1987, 3-37177, and 2-28576) has been proposed.

is a working area;
(2) thinking a specific force is a working area; and
(3) determining a working direction by understanding the

reference image, corresponding change amounts between the changing area and each of two consecutive reference images are calculated by subtracting the reference image from the corresponding image. Moving vectors between the corresponding changing areas are then calculated, and it is determined that the changing areas which have similar moving vectors originate from the same object. This process is repeated for each of the objects.



unit. In this case, it serves as a module for tracking an object and extracting its contour.

(109) Modifications of the candidate extraction processing performed by the candidate extracting section 440 will be described below.

(110) (1) Only information relating to the moving path of each tracking unit, such as position and speed information of each tracking unit within an image, is used to the estimation function used for candidate extraction processing. However, feature amounts of, e.g., **color** and shape, obtained from the tracking area of each tracking unit may be added to the information. Assume that a plurality of tracking units are concurrently tracking body portions of an intruder in red clothing. If the process for determining the identity of the intruder is additionally performed upon extraction of color information from the tracking area of each tracking unit, a candidate can be easily extracted by associating the information from the tracking unit.

(111) (2) The estimation function used for calculating the association strengths between the tracking units in candidate extraction processing may be replaced with the process for extracting a candidate for a moving object by using knowledge associated with the positions

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decreases from the above described elements. In any case, however, a changing area extracted on the basis of a difference does not necessarily correspond to a specific portion of an object.

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For example, the reason why (1) Character is influenced due to the above-mentioned

Find what: color

Area

☐ All

☒ Sel/Del

Direction

☐ Up

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Match word

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Look in

☐ Grid

☒ Documents

Find what

Color

Match word

method of detecting a moving object by only detecting changes on the basis of brightness.

(1) In addition to an existing object, noise caused by environmental variations is detected. It is difficult to discriminate a moving object from the noise. Noise components caused by environmental variations correspond to changes in brightness due to illumination variations or changes in brightness at a given place due to reflection by a wet surface or the like of time, and it grows large differences in picture other than an intruder object. In the conventional method, therefore, objects to be detected cannot be reliably and selectively detected by removing the noise components.

(2) There are objects from which not necessarily appear in a difference image of two tracking objects. For example, a person or the above-mentioned noise, consisting of a plurality of changing areas, appearing from one object, disappears from the previous frame, reappears, and traces of tracking objects when a change area extraction processing cannot be accurately performed.

(3) There is a change area in the line detected in an object together with an intruder or the like, it is very difficult to accurately separate the intruder or the like from the noise. That is, it is very difficult to detect an intruder as one area in an image.

As a method of solving the above-mentioned problems, a noise elimination processing scheme (published in Unexamined Japanese Patent Application Nos. 2-55715, 2-55717, and 2-55718) has been proposed.

In the noise elimination processing scheme as shown in FIG. 1, when a character is appeared in a plurality of changing areas (A, head, body, and leg areas, in a difference image, corresponding change amounts between the changing areas extracted at two consecutive time points are obtained by calculating feature amounts such as area and shape factors. Moving vectors between the corresponding changing areas are also obtained and it is determined whether changing areas which have similar moving vectors originate from the same object. This scheme is effective in that an object is

eliminated the noise elimination processing scheme may not properly function. If the noise elimination processing scheme fails to detect noise properly, tracking areas between noise and an object are tracked, resulting in noise and an object are tracked. However, the tracking areas of the noise are used to analyze, e.g., the movement of a person being in many cases.

According to the tracking method of the tracking areas, a portion to be tracked (e.g., a circle) is attached to an object to be tracked (e.g., a person) or a circle, which is tracked in an image, is tracked. Therefore, it is impossible to selectively detect noise components in a tracking area and track them.

As a method of tracking a moving object in a monitoring area, the following method is also proposed. This method employs a change detecting means for detecting a changing area which changes due to the movement of a moving object such as an intruder, with a tracking means used for the changing area detected by the change detecting means. With this arrangement, the moving object tracked to be present in the changing area is tracked.

For example, the following tracking method is employed by the tracking means described above.

(1) tracking changes in brightness (pixel intensity) in a tracking area;

(2) tracking a specific feature in a tracking area; and

(3) determining a moving direction by calculating the correlation value between a tracking area and peripheral areas.

Since a given tracking means can track only a portion of a moving object, the following method is also proposed. In the method, after tracking processing is completed, tracking results are analyzed, and the tracking means are divided into groups of moving objects (e.g., the tracking means are associated in groups

associating the information from the tracking unit.

(111) (2) The estimation function used for calculating the association strengths between the tracking units in candidate extraction processing may be replaced with the process for extracting a candidate for a moving object by using knowledge associated with the positions and speeds of tracking units, attribute values such as the **colors** and shapes of changing areas which are being tracked, and the preset shape and movement information of an intruder.

(112) An example of this processing will be described below. Processing modules are prepared. Each module compares the respective information described above between two tracking units and converts the comparison result into numerical values indicating whether the compared information are close to each other (i.e., moving objects resemble each other or the same moving object is tracked). Output results from the respective processing modules may be simply added together. Alternatively, the priorities of the respective information are determined, and a weighted sum obtained by weighting in accordance with the priorities is used as an association strength. For example, by using information associated with the shape of an intruder, the probability of obtaining an accurate result

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 DETECTING AND TRACKING AN INTRUDER IN
 A MONITOR ARRANGING
 BACKGROUND OF THE INVENTION
 always appeared from the above-mentioned elements. In many cases, however, a changing area occurred on the basis of a difference that was not immediately accompanied by a specific portion of an object.
 For example, the present case
 (1) Change in information due to the background scene

Find what: color

Area

C All

F Self/Cut

Direction

C Up

C Down

Match word

C Whole

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Look in

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C Grid

C Documents

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method of detecting a moving object by only detecting changes in the background of the background scene.
 (1) In addition to an existing object, a new object is detected by a change in the background scene. In this case, the change in the background scene is detected by a change in the background scene. In this case, the change in the background scene is detected by a change in the background scene.

(2) When a change in the background scene is detected, the change in the background scene is detected by a change in the background scene. In this case, the change in the background scene is detected by a change in the background scene. In this case, the change in the background scene is detected by a change in the background scene.

As a method of solving the above-mentioned problems, a tracking method is proposed. The tracking method is proposed by the tracking method described above.

(1) Tracking changes in brightness (color, luminance) in a tracking area.
 (2) Determining a tracking direction by calculating the correlation value between a tracking area and a background scene.

However, the above-mentioned processing method may not properly function. If the above-mentioned processing method is not properly function, the above-mentioned processing method is not properly function.

In order to solve the above-mentioned problems, a tracking method is proposed. The tracking method is proposed by the tracking method described above.

As a method of solving the above-mentioned problems, a tracking method is proposed. The tracking method is proposed by the tracking method described above.

For example, the following tracking method is proposed by the tracking method described above.

(1) Tracking changes in brightness (color, luminance) in a tracking area.
 (2) Determining a tracking direction by calculating the correlation value between a tracking area and a background scene.

112 explain 111



processing.

(113) (3) Each candidate list formed by the candidate extracting section 440 need not be constituted by only a group of tracking units but may include the overall position information of the candidates and attribute values such as **Color** and shape information obtained from areas to which the tracking units are assigned. In this case, feature extraction processing is performed in addition to candidate extraction processing so that when candidate are extracted by the candidate extraction processing, feature information can be simultaneously extracted from areas in an image in which the candidates exists. The extracted feature information is then added to the candidate information to form a candidate list. If additional attribute values are included in candidate data, association processing is facilitated by adding the process for determining the similarity of attribute values to the process for associating candidates in the result interpreting section 450. In addition, the reliability of the association processing result is increased. The feature extraction processing need not be included in the candidate extraction processing but may be performed parallel as independent processing so that the feature extraction processing can be sequentially performed in response to requests from the candidate extraction processing.

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DETECTING AND TRACKING AN ENTERER IN
A MONITOR IMAGING
BACKGROUND OF THE INVENTION

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Objects are given to the same candidate elements. In
many cases, however, a changing area is tracked on the
basis of a difference that is not immediately accompanied in
a specific portion of an object.
The example, the present area
(1) Character is subjected to the or the character varies

Find what: color

Area	Direction	Match word	Look in	Look at
<input type="radio"/> All	<input type="radio"/> Up	<input type="radio"/> Whole	<input type="radio"/> Left	<input type="radio"/> Grid
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			<input type="radio"/> Match case	

method of detecting a moving object by only detecting
changes on or half of each difference

(1) In addition to an existing object, some cases by
environmental variations is detected. It is difficult to
discriminate or tracking object from the noise. When
comparisons caused by environmental variations corre-
spond to changes in brightness due to illumination vari-
ations or changes in brightness as a given pixel due to
reflections by a wear surface or the edge of frame, and
these large differences in portions other than an existing
object. In the conventional method, therefore, ob-
jects to be detected cannot be reliably and selectively
detected by removing the noise components.

(2) When area changing area does not necessarily ap-
pear in a difference image of two existing objects, pre-
dicted (a.b. occurred in the above-mentioned rule,
monitoring of a changing area originating
from one object, determination of the presence/ab-
sence, position, and shape of tracking object) when-
ever a change area structure processing cannot be
reliably performed.

(3) Since differences of color in the line object is an
important factor with an object or the line, it is very
difficult to clearly separate the number of the line from
the noise. This is, it is very difficult to detect one lo-
cated as one area in an image.

As a method of solving the above-mentioned prob-
lems, a track association processing system (Published in
Unexamined Japanese Patent Application Nos. 5-25774,
5-25777, and 5-25778) has been proposed.

In the above-mentioned processing system, as shown
in FIG. 1, when an object is expressed into a plurality
of changing areas (a. head, body, and leg area, in a
difference image, corresponding change elements be-
tween the changing area obtained at two consecutive
time points are obtained by subtracting feature vectors
such as area and shape features. Moving vectors be-
tween the corresponding changing areas are also obtained
and it is determined whether the changing areas which
have similar moving vectors originate from the same
object. This process is effective in that an object is

detected in the above-mentioned processing system
may not properly function. If the above-mentioned
processing system fails to find an object, however, as
described above, various problems are posed when it is
applied to a monitoring system (display monitoring
system).

In order to solve the above-mentioned problems, a
method using feature vectors of tracking objects is
employed in some cases. In the above-mentioned method,
tracking areas whose moving vectors are tracked, usual-
ly, when between areas need not be performed. However,
the tracking areas of the above-mentioned method, such
as the movement of a human being in many cases.
According to the tracking method of the tracking
areas, a portion to be tracked, such as a number (object)
attached to an object or a property (a. b. in the case of
a case, must be determined in advance. Therefore, it
is impossible to immediately detect many unexpected
objects in a monitoring area and track them.

As a method of tracking unexpected targets in a moni-
tor area, the following method is also proposed. This
method employs a change detecting means for detect-
ing a changing area which changes due to the occur-
rence of a moving object such as an intruder, with a
tracking means aimed at the changing area detected
by the change detecting means. With this arrangement,
the moving object presumed to be present in the chang-
ing area is tracked.

For example, the following tracking methods are
employed by the tracking means described above:

(1) Tracking changes in brightness (pixel luminance)
in a tracking area;

(2) Tracking a specific feature in a tracking area; and

(3) Determining a moving direction by calculating the
correlation value between a tracking area and neigh-
bor area.

Since a given tracking means has such only a portion
of a moving object, the following method is also pro-
posed. In this method, after tracking processing is com-
pleted, tracking results are analyzed, and the tracking
areas are divided into groups in terms of moving ob-
jects (e.g., the tracking areas are associated to groups